Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A method of quantum computing, comprising:

~~providing a qubit, the qubit including a multi-terminal junction wherein two terminals of the multi-terminal junction are coupled to form a superconducting loop, the superconducting loop providing a phase shift;~~

initializing a quantum state in ~~each~~ ~~of the qubits in the~~ an array of qubits, wherein a first qubit in said array of qubits comprises a multi-terminal junction having at least two terminals, wherein two terminals of the at least two terminals are coupled to form a superconducting loop, the superconducting loop providing a phase shift;

performing an algorithm with the array of qubits; and

reading out a ~~final~~ quantum state of ~~each of the~~ qubits in the array.

2. (Currently amended) The method of claim 1, wherein ~~providing a qubit comprises providing a~~ said multi-terminal junction ~~that~~ includes at least one constriction junction.

3. (Currently amended) The method of claim 1, wherein ~~providing a qubit comprises providing a~~ said multi-terminal junction ~~that~~ includes at least one tunnel junction.

4. (Currently amended) The method of claim 1 ~~3~~, ~~wherein providing a~~ the method further comprising constructing said multi-terminal junction ~~with at least one tunnel junction~~ by ~~includes~~ forming an insulating layer separating two of the at least two terminals.

5. (Currently amended) The method of claim 1 [[4]], ~~providing a~~ the method further comprising constructing said multi-terminal junction ~~with at least one tunnel junction includes~~ by forming two terminals of the multi-terminal junction with an s-wave superconducting material.

6. (Currently amended) The method of claim 1, wherein ~~providing a qubit includes providing a~~ said multi-terminal junction ~~that~~ includes at least one two-dimensional electron gas structure.

7. (Currently amended) The method of claim 6, ~~wherein providing a multi-terminal junction that includes one two-dimensional electron gas includes forming a~~ the method further comprising

constructing said two-dimensional electron gas structure by depositing an InAs layer onto an AlSb substrate.

8. (Currently amended) The method of claim 1, wherein ~~providing a qubit includes providing a~~ the superconducting loop ~~that~~ includes a first portion of ~~a~~ an s-wave superconducting material and a second portion of ~~a~~ an s-wave superconducting material, and wherein a portion of the phase shift is produced by a d-wave superconducting material coupled to the first portion and the second portion through normal metal interfaces, the portion of the phase shift being determined by the angle between the normal metal interface and a crystallographic ~~directions~~ direction in the d-wave superconducting material.

9. (Currently amended) The method of claim 1, wherein ~~providing a qubit includes providing a~~ the superconducting loop ~~that~~ includes a first portion of ~~a~~ an s-wave superconducting material and a second portion of ~~a~~ an s-wave superconducting material and wherein a portion of the phase shift is produced by a first d-wave superconducting material coupled through a normal metal to the first portion and a second d-wave superconducting material coupled through a second normal metal to the second portion, the portion of the phase shift being determined by the difference in a crystallographic direction of the first d-wave superconducting material and the second d-wave superconducting material ~~in~~ at a grain boundary interface between the first d-wave superconducting material and the second d-wave superconducting material.

10. (Currently amended) The method of claim 9, ~~wherein providing the superconducting loop includes~~ the method further comprising forming the first d-wave superconducting material and the second d-wave superconducting material on insulating crystals.

11. (Currently amended) The method of claim 9, wherein ~~providing the superconducting loop includes providing~~ the s-wave superconducting material ~~chosen from a group consisting of~~ is made of aluminum ~~Aluminum~~, niobium ~~Niobium~~, lead ~~Lead~~, mercury ~~Mercury~~, ~~and~~ or tin ~~Tin~~.

12. (Currently amended) The method of claim 9, wherein ~~providing the superconducting loop includes providing~~ the d-wave superconducting material is made of ~~from~~ $YBa_2Cu_3O_{7-x}$.

13. (Currently amended) The method of claim 10, wherein ~~forming the first d-wave superconducting material and the second d-wave superconducting material on~~ the insulating crystals ~~includes forming a d-wave material on a material chosen from the group consisting of~~

are made of strontium titanate, sapphire, cerium oxide, or magnesium oxide ~~Strontium Titanate, Sapphire, Cerium Oxide, and Magnesium Oxide~~.

14. (Currently amended) The method of claim 1, wherein ~~forming a qubit includes forming a~~ the superconducting loop ~~that~~ includes a ferromagnetic junction, wherein a portion of the phase shift ~~being~~ is produced by the ferromagnetic junction.

15. (Currently amended) The method of claim 14, wherein ~~forming~~ the superconducting loop includes ~~forming~~ a first portion and a ~~forming~~ second portion wherein the first portion and the second portion are coupled by the ferromagnetic junction.

16. (Currently amended) The method of claim 15, wherein ~~forming~~ the first portion and ~~forming~~ the second portion ~~each include forming portions~~ are made of an ~~from~~ s-wave superconducting material.

17. (Currently amended) The method of claim 16, wherein the s-wave superconducting material is aluminum, niobium, lead, mercury, or tin ~~chosen from the group consisting of Aluminum, Niobium, Lead, Mercury, and Tin~~.

18. (Currently amended) The method of claim ~~16~~ 15, wherein the ferromagnetic junction is formed by copper or ~~Nickel~~ nickel sandwiched between the first portion and the second portion.

19. (Currently amended) The method of claim 15 ~~16~~, ~~wherein~~ the method further comprising forming the superconducting loop ~~includes~~ by implanting a ferromagnetic material into an s-wave superconducting material coupled between the first portion and the second portion.

20. (Currently amended) The method of claim 1, wherein ~~forming the qubit includes forming a~~ the superconducting loop is made of ~~from~~ a d-wave superconducting material and wherein a portion of the phase shift is formed by a grain boundary ~~boundaries~~ in the d-wave superconducting material of the superconducting loop.

21. (Currently amended) The method of claim 1, wherein the initializing ~~the quantum state~~ includes applying a transport ~~currents~~ current to the superconducting loop through terminals of the multi-terminal junctions.

22. (Currently amended) The method of claim 21, wherein the applying the transport ~~currents~~ current includes

applying a current asymmetrically through the multi-terminal junction in a first direction, ~~to initialize a first state~~ and

applying a current asymmetrically through the multi-terminal junction in a second direction ~~to initialize a second state~~.

23. (Currently amended) The method of claim 1, wherein the initializing ~~the quantum state~~ includes reading the first qubit and providing a current symmetrically through the multi-terminal junction ~~if~~ when the first qubit is in a state opposite to a predetermined state.

24. (Currently amended) The method of claim 1, wherein the initializing ~~the quantum state~~ includes applying an external magnetic field to the first qubit.

25. (Currently amended) The method of claim 1, wherein reading out the ~~final~~ quantum state includes applying a transport current asymmetrically through the multi-terminal junction and measuring a voltage across the multi-terminal junction.

26. (Original) The method of claim 25, wherein measuring the voltage across the multi-terminal junction comprises using a radio frequency single electron transistor electrometer.

27. (Currently amended) The method of claim 25, wherein applying ~~a~~ the transport current includes applying a transport current that is both

(i) greater than a critical current of the multi-terminal junction corresponding to a first state, and

(ii) smaller than a critical current of the multi-terminal junction corresponding to a second state.

28. (Currently amended) The method of claim 27, further including

determining the quantum state to be the first state ~~if~~ when no voltage is measured across the multi-terminal junction and,

determining the quantum state to be the second state ~~if~~ when a voltage is measured across the multi-terminal junction.

29. (Currently amended) The method of claim 1, wherein reading out the ~~final~~ quantum state includes measuring the direction of the magnetic field of the superconducting loop with a magnetic force microscope.

30. (Currently amended) The method of claim 1, wherein reading out the ~~final~~ quantum state includes measuring the magnetic field of the superconducting loop with a SQUID loop.

31. (Currently amended) The method of claim 1, wherein reading out the ~~final~~ quantum state includes measuring the magnetic field of the superconducting loop with a Hall probe.

32. (Currently amended) The method of claim 1, wherein performing ~~an~~ said algorithm includes externally applying magnetic fields to the first qubit.

33. (Currently amended) The method of claim 1, wherein performing ~~an~~ said algorithm includes applying transport currents through the multi-terminal junction.

34. (Currently amended) The method of claim 1, wherein performing ~~an~~ said algorithm includes performing a σ_x phase gate operation or a σ_z phase gate operation.

35. (Currently amended) The method of claim 34, wherein performing ~~a~~ said σ_x phase gate operation includes passing a pulse of current symmetrically through the multi-terminal junction.

36. (Currently amended) The method of claim 34, wherein performing ~~a~~ said σ_z phase gate operation includes passing a pulse of current asymmetrically through the multi-terminal junction.

37. (Currently amended) The method of claim 1, further comprising:

~~providing a second qubit; and~~

coupling ~~the~~ a second qubit in the array of qubits with the first qubit ~~with~~ using an entanglement junction, wherein the performing an algorithm further includes controlling an entanglement between a quantum state of the first qubit with a quantum state of the second qubit.

38. (Currently amended) The method of claim 37, wherein controlling the entanglement includes:

capacitively coupling a voltage into the entanglement junction in order to remove an entanglement, and

removing the voltage to provide an entanglement.

39. (Original) The method of claim 1, wherein the multi-terminal junction includes five-terminals and wherein initializing a quantum state includes passing a transport current directionally and asymmetrically through the five-terminal junction for a sufficient period of time for a quantum state of the superconducting loop coupled to the five-terminal junction to relax into the preferred state.

40. (Currently amended) The method of claim 39, wherein reading out the ~~final~~ state includes applying a current asymmetrically through the five-terminal junction and measuring a voltage across the five-terminal junction, the current being between a first critical current and a second critical current, and wherein absence or presence of the voltage ~~indicating~~ indicates the quantum state of the first qubit.

41. (Original) The method of claim 39, wherein performing an algorithm includes performing a first gate operation by passing a pulse of current asymmetrically through the multi-terminal junction or performing a second gate operation by passing a pulse of current symmetrically through the multi-terminal junction.

42. (Currently amended) The method of claim 41, wherein the duration and intensity of transport currents that perform the first phase gate operation and the second phase gate operation are short enough and small enough respectively such that the quantum state of the first qubit is not destroyed by the operation.

43. (Canceled)

44. (Currently amended) The method of claim 1 ~~43~~, wherein a second qubit in the said array of qubits comprises a second multi-terminal junction having at least two terminals, wherein two terminals of the at least two terminals are coupled to form a second superconducting loop ~~providing the at least one other qubit includes forming a second superconducting loop by coupling a second pair of terminals of the multi-terminal junction of the qubit~~.

45. (Currently amended) The method of claim 44 ~~43~~, wherein the ~~providing the at least one other~~ second qubit is coupled to the first qubit ~~includes coupling the qubit to the at least one of the at least one other qubit~~ through the multi-terminal ~~junctions~~ junction of the first qubit and the multi-terminal junction of the second qubit.

46. (Currently amended) The method of claim 44 ~~43~~, further including coupling the ~~at least one other~~ second qubit with the first qubit through an entanglement junction.

47. (Currently amended) The method of claim 1, the method further including tuning the first qubit.

48. (Currently amended) The method of claim 47, wherein said tuning the first qubit includes passing a current symmetrically through the multi-terminal junction.

49. (Currently amended) The method of claim 47, wherein said tuning the first qubit includes passing a current symmetrically through the multi-terminal junction so that a tunneling frequency for the first qubit matches a tunneling frequency of other qubits in ~~an~~ the array of qubits.

50. (Currently amended) A method of initializing a qubit, comprising:

providing a first qubit, the first qubit including a superconducting loop coupled to a multi-terminal junction, the superconducting loop providing a phase shift; and

passing current asymmetrically through the multi-terminal junction in a selected direction for a sufficient amount of time to induce a ~~selected~~ predetermined quantum state on the superconducting loop of the ~~quantum~~ first qubit.

51. (Currently amended) The method of claim 50, wherein ~~providing a qubit comprises providing a~~ said multi-terminal junction ~~that~~ includes at least one constriction junction.

52. (Currently amended) The method of claim 50, wherein ~~providing a qubit comprises providing a~~ said multi-terminal junction ~~that~~ includes at least one tunnel junction.

53. (Currently amended) The method of claim 50, wherein ~~providing a qubit includes providing a~~ said multi-terminal junction ~~that~~ includes at least one two-dimensional electron gas structure.

54. (Currently amended) The method of claim 50, wherein ~~providing a qubit includes providing a~~

said superconducting loop ~~that~~ includes a first portion of ~~a~~ an s-wave superconducting material and a second portion of ~~a~~ an s-wave superconducting material and wherein

a portion of the phase shift is produced by a d-wave superconducting material coupled to the first portion and the second portion through normal metal interfaces, the portion of the phase shift being determined by the angle between the normal metal interface and a crystallographic ~~directions~~ direction in the d-wave superconducting material.

55. (Currently amended) The method of claim 50, wherein ~~providing a qubit includes providing a~~ the superconducting loop ~~that~~ includes a first portion made of ~~a~~ an s-wave superconducting material and a second portion made of ~~a~~ an s-wave superconducting material and wherein a portion of the phase shift is produced by a first d-wave superconducting material coupled through a normal metal to the first portion and a second d-wave superconducting material coupled through a second normal metal to the second portion, the portion of the phase shift being determined by the difference in a crystallographic direction of the first d-wave superconducting material and the second d-wave superconducting material ~~in~~ at a grain boundary interface between the first d-wave superconducting material and the second d-wave superconducting material.

56. (Currently amended) The method of claim 50, wherein ~~forming a qubit includes forming a~~ the superconducting loop ~~that~~ includes a ferromagnetic junction, and wherein a portion of the phase shift ~~being~~ is produced by the ferromagnetic junction.

57. (Currently amended) The method of claim 56 ~~50~~, wherein ~~forming~~ the superconducting loop includes ~~forming~~ a first portion and a ~~forming~~ second portion and wherein the first portion and the second portion are coupled by the ferromagnetic junction.

58. (Currently amended) The method of claim 50, wherein ~~forming the qubit includes forming a~~ the superconducting loop is made of ~~from~~ a d-wave superconducting material and wherein a portion of the phase shift is formed by a grain ~~boundaries~~ boundary in the d-wave superconducting material of the superconducting loop.

59. (Original) The method of claim 50, wherein the multi-terminal junction is a five-terminal junction.

60. (Currently amended) The method of claim 50, wherein ~~if~~

when the ~~selected~~ predetermined quantum state is a first state, then initializing the quantum state includes passing current asymmetrically through the multi-terminal junction in a first direction.

61. (Currently amended) The method of claim 60 ~~50~~, wherein ~~if~~

when the ~~selected~~ predetermined quantum state is a second state, then initializing the quantum state includes passing current asymmetrically through the multi-terminal junction in a second direction opposite the first direction.

62. (Currently amended) A method of performing a phase gate operation, comprising:

providing a qubit, the qubit including a superconducting loop coupled to a multi-terminal junction, the superconducting loop providing a phase shift; and

passing current through the multi-terminal junction.

63. (Currently amended) The method of claim 62, wherein ~~providing a qubit comprises providing a~~ said multi-terminal junction ~~that~~ includes at least one constriction junction.

64. (Currently amended) The method of claim 62, wherein ~~providing a qubit comprises providing a~~ the multi-terminal junction ~~that~~ includes at least one tunnel junction.

65. (Currently amended) The method of claim 62, wherein ~~providing a qubit includes providing a~~ the multi-terminal junction ~~that~~ includes at least one two-dimensional electron gas structure.

66. (Currently amended) The method of claim 62, wherein ~~providing a qubit includes providing a~~

the superconducting loop ~~that~~ includes a first portion of ~~a~~ an s-wave superconducting material and a second portion of ~~a~~ an s-wave superconducting material, and wherein

a portion of the phase shift is produced by a d-wave superconducting material coupled to the first portion and the second portion through normal metal interfaces, the portion of the phase shift being determined by the angle between the normal metal interface and a crystallographic ~~directions~~ direction in the d-wave superconducting material.

67. (Currently amended) The method of claim 62, wherein ~~providing a qubit includes providing a~~ the superconducting loop ~~that~~ includes a first portion of ~~a~~ an s-wave superconducting material and a second portion of ~~a~~ an s-wave superconducting material and wherein a portion of the phase shift is produced by a first d-wave superconducting material coupled through a normal metal to the first portion and a second d-wave superconducting material coupled through a second normal metal to the second portion, the portion of the phase shift being determined by the difference in a crystallographic direction of the first d-wave superconducting material and the second d-wave superconducting material ~~in~~ at a grain boundary interface between the first d-wave superconducting material and the second d-wave superconducting material.

68. (Currently amended) The method of claim 62, wherein ~~forming a qubit includes forming a~~ the superconducting loop ~~that~~ includes a ferromagnetic junction, and wherein a portion of the phase shift ~~being~~ is produced by the ferromagnetic junction.

69. (Currently amended) The method of claim 68 ~~62~~, wherein ~~forming~~ the superconducting loop includes ~~forming~~ a first portion and a ~~forming~~ second portion and wherein the first portion and the second portion are coupled by the ferromagnetic junction.

70. (Currently amended) The method of claim 62, wherein ~~forming the qubit includes forming a~~ the superconducting loop ~~from~~ is made of a d-wave superconducting material and wherein a portion of the phase shift is formed by a grain ~~boundaries~~ boundary in the d-wave superconducting material of the superconducting loop.

71. (Currently amended) The method of claim 62, wherein the phase gate operation is a σ_x operation and said passing ~~a~~ said current through the multi-terminal junction includes passing current symmetrically through the multi-terminal junction.

72. (Currently amended)The method of claim 62, wherein the phase gate operation is σ_z operation and said passing ~~a~~ said current through the multi-terminal junction includes passing current asymmetrically through the multi-terminal junction.

73. (Currently amended) The method of claim 62, wherein the multi-terminal junction is arranged so that current can pass through the multi-terminal junction both symmetrically and asymmetrically.

74. (Currently amended) The method of claim 62 ~~73~~, wherein the multi-terminal junction is a five-terminal junction.

75. (Original) The method of claim 62, wherein the multi-terminal junction is a four-terminal junction.

76. (Original) A method of reading a state of a qubit, comprising:

providing a qubit, the qubit including a superconducting loop coupled to a multi-terminal junction, the superconducting loop providing a phase shift;

applying a current asymmetrically through the multi-terminal junction; and

determining whether a resistance has developed across the multi-terminal junction, wherein absence of a resistance across the multi-terminal junction indicates a first state and presence of resistance across the multi-terminal junction indicates a second state.

77. (Currently amended) The method of claim 76, wherein ~~providing a qubit comprises providing a~~ the multi-terminal junction ~~that~~ includes at least one constriction junction.

78. (Currently amended) The method of claim 76, wherein ~~providing a qubit comprises providing a~~ the multi-terminal junction ~~that~~ includes at least one tunnel junction.

79. (Currently amended) The method of claim 76, wherein ~~providing a qubit includes providing a~~ the multi-terminal junction ~~that~~ includes at least one two-dimensional electron gas structure.

80. (Currently amended) The method of claim 76, wherein ~~providing a qubit includes providing a~~ the superconducting loop ~~that~~ includes a first portion of ~~a~~ an s-wave superconducting material and a second portion of ~~a~~ an s-wave superconducting material and wherein a portion of the phase shift is produced by a d-wave superconducting material coupled to the first portion and the second portion through normal metal interfaces, the portion of the phase shift being determined by the angle between the normal metal interface and a crystallographic ~~directions~~ direction in the d-wave superconducting material.

81. (Currently amended) The method of claim 76, wherein ~~providing a qubit includes providing a~~ the superconducting loop ~~that~~ includes a first portion of ~~a~~ an s-wave superconducting material and a second portion of ~~a~~ an s-wave superconducting material and wherein a portion of the phase shift is produced by a first d-wave superconducting material coupled through a normal

metal to the first portion and a second d-wave superconducting material coupled through a second normal metal to the second portion, the portion of the phase shift being determined by the difference in a crystallographic direction of the first d-wave superconducting material and the second d-wave superconducting material ~~in~~ at a grain boundary interface between the first d-wave superconducting material and the second d-wave superconducting material.

82. (Currently amended) The method of claim 76, wherein ~~forming a qubit includes forming a~~ the superconducting loop ~~that~~ includes a ferromagnetic junction, and wherein a portion of the phase shift ~~being~~ is produced by the ferromagnetic junction.

83. (Currently amended) The method of claim 82 ~~76~~, wherein ~~forming~~ the superconducting loop includes ~~forming~~ a first portion and a ~~forming~~ second portion and wherein the first portion and the second portion are coupled by the ferromagnetic junction.

84. (Currently amended) The method of claim 76, wherein ~~forming the qubit includes forming a~~ the superconducting loop ~~from~~ is made of a d-wave superconducting material and wherein a portion of the phase shift is formed by a grain ~~boundaries~~ boundary in the d-wave superconducting material of the superconducting loop.

85. (Currently amended) The method of claim 76, wherein the current is both:

(i) greater than a lower critical current of the multi-terminal junction when the qubit is in the second state, and

(ii) less than a greater critical current of the multi-terminal junction when the qubit is in the first state.

86. (Currently amended) The method of claim 76 ~~85~~, wherein the multi-terminal junction is a four-terminal junction.

87. (Original) The method of claim 76, wherein the multi-terminal junction is a five terminal junction.

88. (Currently amended) A method of entangling two qubits in a qubit array, comprising:

switchably capacitively coupling a voltage into an entanglement junction, the entanglement junction being coupled between a first superconducting ~~loops~~ loop of a first qubit

in the qubit array and a second superconducting loop of a second qubit in the qubit array ~~of the two qubits~~.

89. (Currently amended) The method of claim 88, wherein at least one of the ~~two qubits~~ first qubit and the second qubit includes a superconducting loop coupled to a multi-terminal junction, the superconducting loop providing a phase shift.

90. (Currently amended) The method of claim 88 ~~97~~, wherein the quantum ~~states~~ state of the first qubit and the quantum state of the second qubit ~~of the two qubits~~ are entangled in the absence of the voltage.

91. (Currently amended) A method of tuning a qubit in a qubit array, comprising:

providing a qubit, the qubit including a superconducting loop coupled to a multi-terminal junction, the superconducting loop providing a phase shift; and

providing a current symmetrically through the multi-terminal junction, the current adjusting a tunneling frequency between a first quantum ~~states~~ state and a second quantum state ~~on~~ of the qubit.

92. (Currently amended) The method of claim 91, ~~wherein~~ the method further comprising ~~the tunneling frequency is adjusted~~ adjusting the tunneling frequency to correspond to the tunneling frequency of ~~other~~ another ~~qubits~~ qubit in ~~a~~ the qubit array.